

**Class II Permit Application #WY22425-12116,
Brinkerhoff 3A Well (API: 49-013-06977),
Completeness and Preliminary Technical Review**

Application Form:

1. The 7520-6 permit application form and attachments indicate the purpose of the conversion is for enhanced oil recovery (EOR); however, the cover letter indicates the application is for saltwater disposal. Please clarify whether the conversion of the well is for EOR or disposal.

Area of Review (AOR) and Corrective Action:

2. Please provide the current list of landowners and addresses within ¼ mile of the Tribal C-14 facility boundary as required in 40 Code of Federal Regulations (CFR) 144.31(e)(9).
3. Please provide all available well construction, completion records and sundry notices for wells located within the AOR that penetrate the confining zone as required in 40 CFR 146.7(g).
4. Section L of the permit application indicates that the Brinkerhoff 3 well was plugged and abandoned in 1966 after many joints of tubing became stuck in the hole. Please provide plugging records and a diagram depicting the completion details and final plugging and abandonment of the Brinkerhoff 3 well. Additionally, please provide the lateral distance in feet (ft.) between the Brinkerhoff 3 and 3A well bores.
5. Well records on file with the Wyoming Oil and Gas Conservation Commission (WOGCC) indicate that the Brinkerhoff 3 well was drilled in 1959 with perforations in the Tensleep Formation and was subsequently recompleted with perforations in the Dakota Formation in 1966.

The Table in Exhibit B-1 indicates that the top of cement behind the production casing for the Brinkerhoff 3 well is 2,700 ft. based on a calculation of cement circulated through a D.V. tool reportedly located at 4,708 ft. The Plugging and Abandonment (P&A) Plan for the Brinkerhoff 3A well in Exhibit I also indicates an estimated top of cement behind production casing of 2,700 ft. with a D.V. tool set at 4,708 ft. Please provide the supporting well records and cement bond log (CBL) that verify the location of the D.V. tool (whether at the Brinkerhoff 3 or 3A well), reported cement volume and top of cement. Additionally, please provide the top of cement above the original seven (7) inch casing completed to a depth of 7,076 ft. in 1959 for the Brinkerhoff 3 well.

Please be advised that the permit applicant must make a clear demonstration that the Brinkerhoff 3 well was completed and subsequently abandoned in such a way that it does not represent a conduit for movement of injected fluids out of the Crow Mountain Sandstone Member of the Chugwater Formation. Failure to make an adequate demonstration may result in denial of a Class II permit or incorporation of a corrective action requirement to ensure isolation of the proposed injection zone.

6. In support of a determination regarding corrective action under 40 CFR 146.7, please provide an indication as to whether any existing, proposed, or plugged and abandoned well conditions exist that represent a potential pathway for out of zone injection.

Injection and Confining Zone Geology:

7. The formation top and bottom depths presented in the Brinkerhoff 3A UIC Application AOR Review spreadsheet appear to have been duplicated from the information included with the recent Tribal C-13 permit modification application. The Tribal C-13 well is located approximately three (3) miles northeast, and the formation top and bottom depths are not adequate or representative of the geologic conditions that exist at the location of the Brinkerhoff 3A well.

Please provide the formation top and bottom depths and a lithologic description of each formation or named stratigraphic unit from surface to the depth of the deepest well completed in the AOR.

8. Section G of the permit application indicates that the Crow Mountain Sandstone is 999 ft. thick; this thickness corresponded to the entire thickness of the Chugwater Formation. The aquifer exemption attachment indicates that the Crow Mountain Sandstone is 113 ft. thick. Please clarify whether the entire 999 ft. Chugwater Formation is being proposed as the injection zone or only the interval containing the Crow Mountain Sandstone Member reportedly occurring between 5,700 feet-Kelly Bushing (ft-KB) and 5,813 ft-KB. If the entire Chugwater Formation is being proposed as the injection zone, the confining intervals identified in the aquifer exemption attachment will need to be updated.
9. As provided in 40 CFR 146.24(5), please provide the following geologic data to support the application:
 - a. Estimates of the permeability (if available) and net thickness of the porous/permeable portion of the injection zone. For example, is the entire 113 ft. of the Crow Mountain Sandstone considered porous/permeable as evidenced by open hole logs, or is there a smaller interval coincident with the existing ten (10) ft. perforated interval within the unit that is expected to receive the majority of the injected fluid?

- b. An estimate of the net shale/impermeably unit thickness and permeability of the upper and lower confining zones.
 - c. Describe any known or suspected faults or fracture systems (e.g. Steamboat Butte Fault System to the west of the Brinkerhoff 3A well) and provide the proximity to the injection zone and the effect the fault or fracture system may have on injection activities.
 - d. A description of the nearest out-crop of the Chugwater Formation and/or Crow Mountain Sandstone Member relative to the Brinkerhoff 3A well with accompanying geologic map.
 - e. North-to-south and west-to-east oriented stratigraphic and structural cross-sections using well logs from off-set wells extending through the ¼ mile AOR. The cross-sections should depict formation tops, upper and lower confining zones, the injection zone, and known or potential USDWs above and below the injection zone.
 - f. Any available structural geologic or formation isopach maps for the injection zone or confining zones within the AOR.
 - g. Any available open or cased hole logs for the Brinkerhoff 3A well.
10. Section L of the application indicates that the Brinkerhoff 3A well was sand frac'd in 1983. The upper confining zone described in the aquifer exemption attachment is 161 ft. thick. Please provide a modeled estimate of the fracture height generated by the 1983 well stimulation activities and an assessment as to whether this activity may have propagated fractures in the upper confining zone.
11. In support of a determination that operation of the well as a Class II EOR well conforms to the prohibition of fluid movement contained in 40 CFR 144.12(a), please provide an evaluation as to whether the upper and lower confining zones consist of impermeable barriers of sufficient thickness and lateral extent to prevent movement of fluid out of the proposed injection zone within the AOR.

Underground Source of Drinking Water (USDW) Evaluation:

12. The information on USDWs appears to represent the same data points as those reported for the recent Tribal C-13 permit modification application, and this data was derived from an earlier application submitted in 2006. Please provide a current and updated summary of formation water quality data (i.e. maximum, minimum, median) available for the Steamboat Butte Field. One source of information pertaining to formation water quality

sample results may be found at https://www.usgs.gov/centers/eersc/science/oil-and-gas-waters-project?qt-science_center_objects=0#qt-science_center_objects.

13. The table of possible USDWs in Section E of the permit application does not include any water quality information pertaining to the Nugget, Sundance, Lakota or Dakota Sandstones located above the proposed injection zone or the Dinwoody, Phosphoria and Tensleep Formations located below the proposed injection zone. Please provide any water quality data for these formations and stratigraphic units.

Specifically, please provide an indication of the maximum, minimum, and median Total Dissolved Solids (TDS) concentrations and USDW status of these units. If no water quality sample results are available, please provide estimates of TDS concentrations from the cleanest water-bearing zones of the units using available open-hole resistivity and porosity logs from the Brinkerhoff 3A well or other off-set wells.

Faults, Fractures, Seismicity:

14. As provided under 40 CFR 146.24(5), please provide a brief evaluation of seismic risk associated with the proposed injection well, whether by injection induced seismicity or damage to the well potentially resulting from regional seismic events. Information pertaining to seismic risk and historically recorded seismic events in the region may be obtained from <https://earthquake.usgs.gov/>.

Well Construction:

15. Please provide the results of a Part I casing pressure test for the Brinkerhoff 3A well. If such testing results are not available, please submit a plan to perform this testing in accordance with EPA Region 8, Guidance Document #39 to support a determination that the well has mechanical integrity, as defined in 40 CFR 146.8(a)(1). This guidance document can be found at <https://www.epa.gov/uic/underground-injection-control-epa-region-8-co-mt-nd-sd-ut-and-wy>.
16. Please provide a cement bond log (CBL) for the Brinkerhoff 3A well. Additionally, please provide an evaluation of the CBL in the confining zones located above and below the proposed injection zone and relative to the two (2) former perforation sets occurring between 6,692-6,712 ft-KB and 6,774-6,785 ft-KB.

This evaluation should include calculation of an 80% bond index, identification of any zones of poor cement bond, and an indication as to whether the CBL supports that the well is cased and cemented in a manner that will prevent movement of fluids into or between underground sources of drinking water, pursuant to the requirements of 40 CFR 146.22(b) and 40 CFR 146.8(a)(2). Guidance No. 34 located at <https://www.epa.gov/uic/underground-injection-control-epa-region-8-co-mt-nd-sd-ut-and-wy> includes additional information on CBL analysis.

17. The well diagram included as exhibit H indicates that a cement retainer has been set at 6,180 ft-KB and a cast iron bridge plug set at 6,760 ft-KB. Please provide records documenting the abandonment and volume of cement squeezed for the two (2) perforation sets occurring between 6,692-6,712 ft-KB and 6,774-6,785 ft-KB. If no cement was placed on top of the cement retainer set at 6,180 ft-KB, please provide a plan to pressure test the retainer and top with a cement plug of at least 20 feet (and preferably 100 feet) as part of the proposed injection well conversion.
18. As required in 40 CFR 146.22(b)(1), all Class II injection wells shall be cased and ***cemented*** to prevent movement of fluids ***into or between*** USDWs. Pending the results of the responses to comment nos. 4, 9, 10 and 11, a work plan may be requested to isolate USDWs and incorporated as a pre-injection requirement for the conversion of the Brinkerhoff 3A well.

Operating Conditions:

19. Please provide a flow diagram of fluid flow through the facility and a diagram of the facility surface construction, as described in Section K of the application. The diagram of the facility surface construction should depict the approximate location of devices to monitor the nature of the injected fluids, injection pressure, annulus pressure, flow rate, etc.
20. The fracture gradients referenced in the application are for the Tensleep and/or Phosphoria Formations in the Steamboat Butte Field. Please provide any available regional fracture gradients calculated for the Crow Mountain Sandstone Member of the Chugwater Formation. If no fracture gradient data is available, EPA intends to conservatively assign a fracture gradient of 0.5 pounds per square inch per foot (psi/ft) to calculate a temporary Maximum Allowable Surface Injection Pressure (MAIP) until a step-rate test has been run to determine the actual fracture gradient of the injection zone.

Plugging and Abandonment:

21. The Plugging and Abandonment Procedure contained in Exhibit I includes well information for the Tribal C-13. Please provide a corrected procedure and accompanying diagram that includes the following:
 - h. Type and number of plugs to be used;
 - i. Type and density of fluid that will be left in place in between plugs;
 - j. Placement of each plug including the elevation of top and bottom;
 - k. Type, grade, and quantity of cement to be used; and
 - l. Method of placement of the plugs.
 - m. P&A Diagram

Additionally, please be advised that in order to satisfy the requirements of 40 CFR 146.10, the procedure must include provisions for isolating USDWs within any uncemented

portions of the five and one-half (5.5) inch production casing. Further, the plugging abandonment procedure should be consistent with EPA Guidance Document #40. This guidance document can be found at <https://www.epa.gov/uic/underground-injection-control-epa-region-8-co-mt-nd-sd-ut-and-wy>.

Financial Responsibility:

22. Please provide two (2) independent, third-party cost estimates based on the revised and corrected P&A procedure requested in comment no. 18 above. If P&A cost estimates are greater than the \$64,000 financial assurance currently held by EPA for the Brinkerhoff 3A well, an increase in the financial assurance will be requested.

National Historic Preservation Act and Endangered Species Act Considerations:

23. Please describe whether the proposed conversion will result in any new surface disturbances outside of the existing well pad.

Aquifer Exemption Request:

24. The aquifer exemption (AE) request for the Crow Mountain Member of the Chugwater Formation includes an area of 2,480 acres; however, the Brinkerhoff 3A is the only EOR injection well completed in this zone that is proposed for the Steamboat Butte Field. As a result, approval of an AE would be limited to the AOR extent for the Brinkerhoff 3A well unless a demonstration can be made that the proposed EOR activities will affect a larger area.
25. Please provide well depth and formation of completion for each well in the table of water wells identified in the Wyoming State Engineer's Office database.
26. Please provide the laboratory analytical results for the production water sample collected from the Brinkerhoff 4 well and clarify whether the sample was collected before or after the fracture stimulation described in Section L of the permit application.
27. Please provide an indication of the regional groundwater flow direction in the Crow Mountain Sandstone Member of the Chugwater Formation. If available, this may be interpolated from reservoir pressure data from production wells completed in the formation.